TB 11-1505-3

WAR DEPARTMENT TECHNICAL BULLETIN

RADIO SET SCR-296-A; RANGE UNIT BC-723-A,

INSTALLATION OF RANGE AIDED TRACKING AND RANGE DATA TRANSMITTER KIT A96-U1

References: TM 11–1305, TM 11–1405, TM 11–1505: Radio Set SCR–296–A

WAR DEPARTMENT 31 OCTOBER 1944

CONFIDENTIAL

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TB 11–1505–3, Radio Set SCR–296–A; Range Unit BC–723–A, Installation of Range Aided Tracking and Range Data Transmitter Kit A96–U1, is published for the information and guidance of all concerned.

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4; (3) T/O-E 4-232, 4-240.

IC 11; T/O-E 11-107, 11-237, 11-587, 11-592, 11-597, 11-617.

(For explanation of symbols see FM 21–6.)

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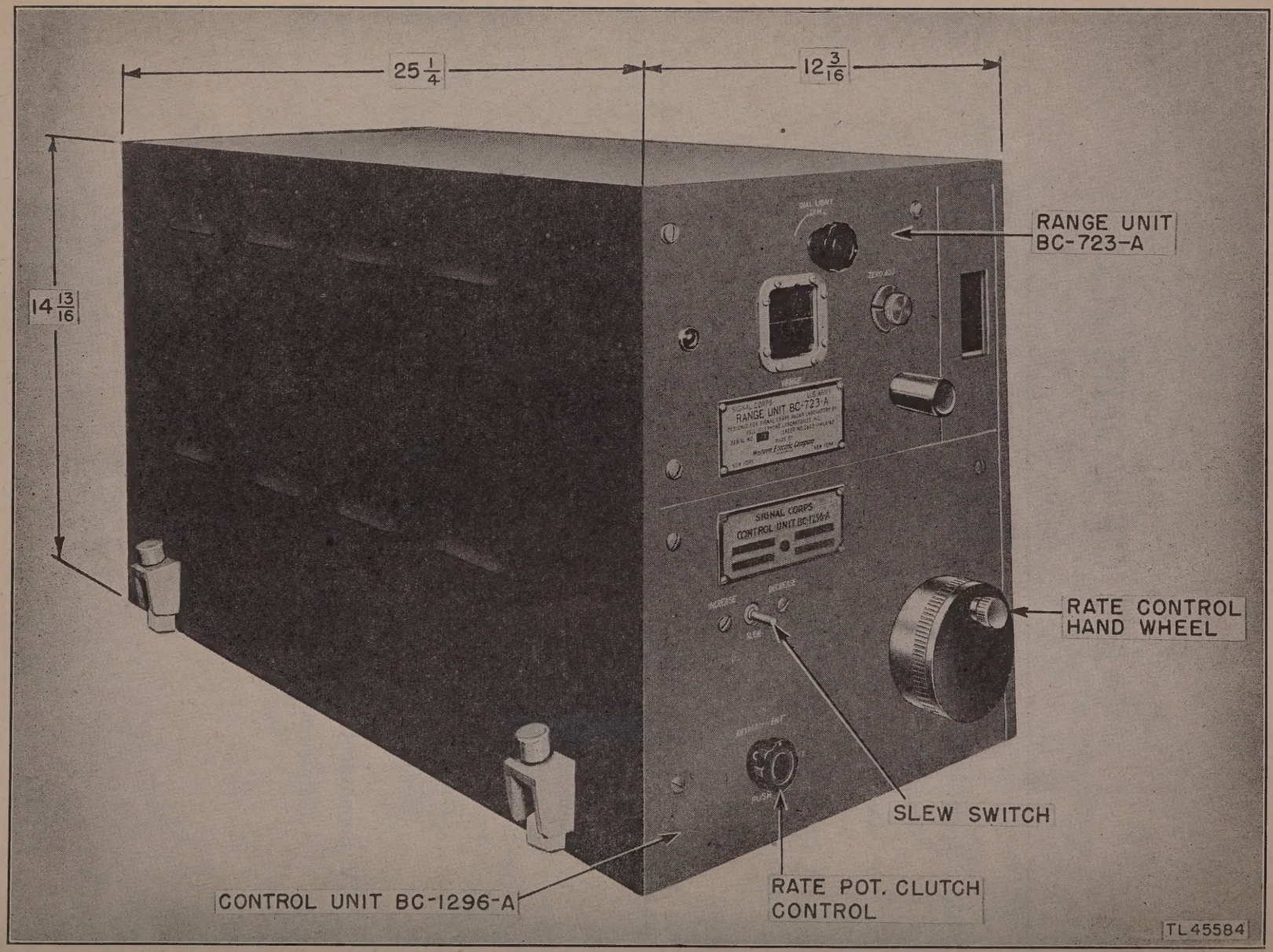

Figure 1. Combined Range Unit BC–723–A and Control Unit BC–1296–A.

Radio Set SCR-296-A; Range Unit BC-723-A,

INSTALLATION OF RANGE AIDED TRACKING AND RANGE DATA TRANSMITTER KIT A96–U1

SECTION I

GENERAL DESCRIPTION

1. PURPOSE.

a. Range Aided Tracking and Range Data Transmitter Kit A96–U1 is used on Radio Set SCR–296–A. It consists of two Control Units BC–1296–A (one spare) complete with vacuum tubes, data potentiometers, and complete equipment for one installation.

b. Control Unit BC–1296–A is for use in connection with Range Unit BC–723–A to provide aided tracking and potentiometer data transmission in range. It is to be installed in the location formerly occupied by the range unit, which will be mounted on and within the new unit to form a single assembly. The size of the control unit and the range unit combined is $12\frac{3}{16}$ inches wide, $14\frac{13}{16}$ inches high, and $25\frac{1}{4}$ inches deep (fig. 1).

c. The control unit is so designed as to require the minimum of change in existing equipment. The additional power required is as follows:

(1) From the system power supply at Range Oscilloscope BC–719–A: 115 volts, 60-cycles, a-c.

(2) From Rectifier RA–49–A, through cabling already provided for the range unit: 250 volts, 100 milliamperes, d-c.

2. DESCRIPTION (figs. 2, 3, and 4).

a. Control Unit BC–1296–A has a cast brass base and frame in the front half of which is mounted the aid mechanism, including motors, data potentiometer, etc. The associated amplifier is mounted on the rear of the base. The frame above the aid mechanism is arranged for seating and clamping the range unit, after slight modification of the latter. The front panels of both units are flush after the assembly, and a cover (part of the control unit) incloses all except the fronts of the combined units.

b. The mechanism of Range Unit BC–723–A is driven, through reduction gearing, by a motor in the control unit. The speed and direction of rotation of this motor is controlled through the action of a component amplifier, generator, and rate control potentiometer, by turning a handwheel on the front panel of the unit. A cushioned spur gear projects from the top of the control unit and meshes with the mechanisms of both the control unit and the range unit. The position of this gear is adjustable to permit exact alignment with the range unit gearing.

c. All external electrical connections to both the control unit and the range unit are made to a terminal strip mounted on the control unit base, from which cabled connections extend to the components of both units.

d. Four vacuum tubes, which are listed and described in standard tube books, are used in the operation of the amplifier. These tubes are located as follows:

(1) Two type 6SL7GT tubes in positions V1 and V2.

(2) Two type 6V6GT tubes in positions V3 and V4.

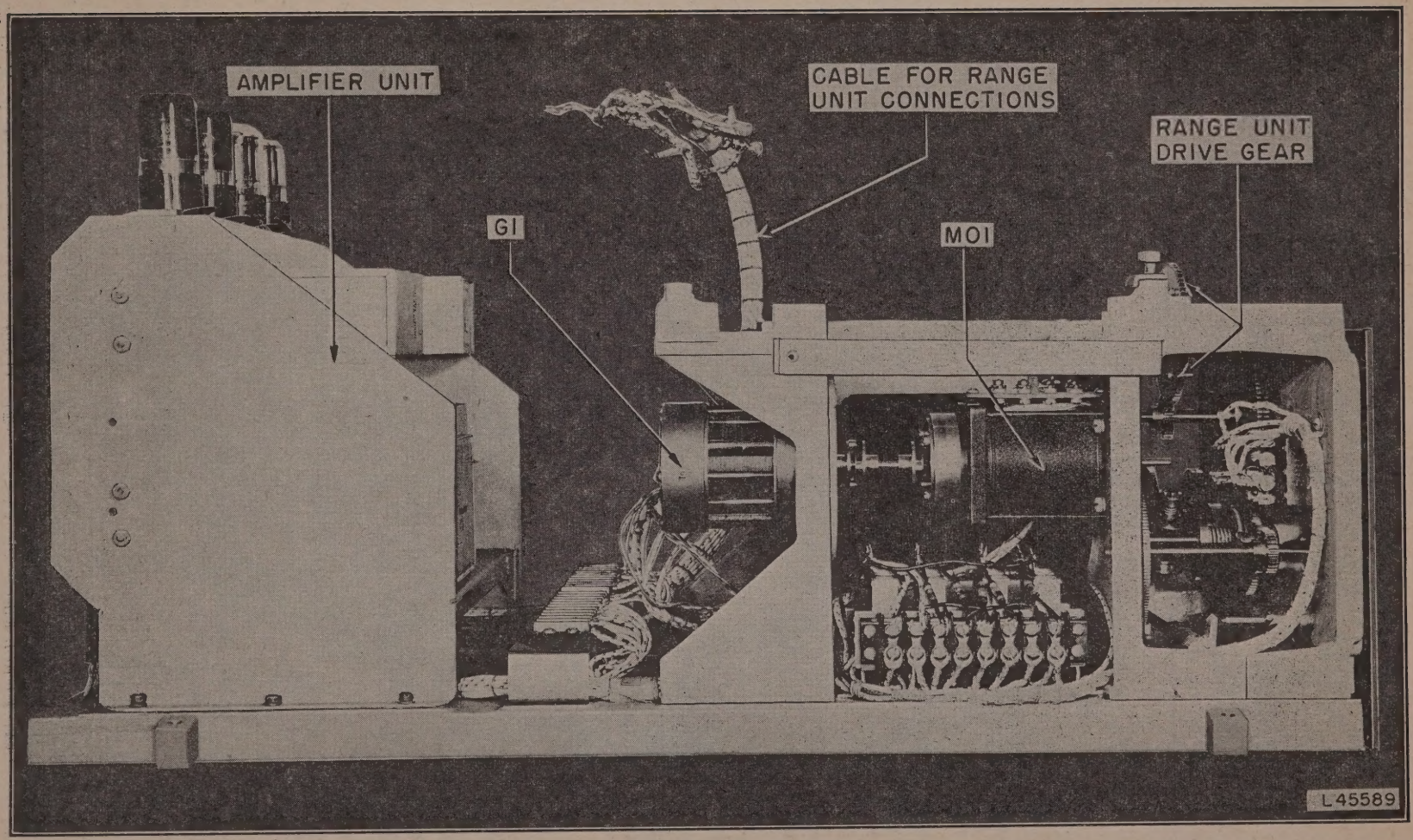

Figure 2. Control Unit BC–1296–A, left side view of chassis.

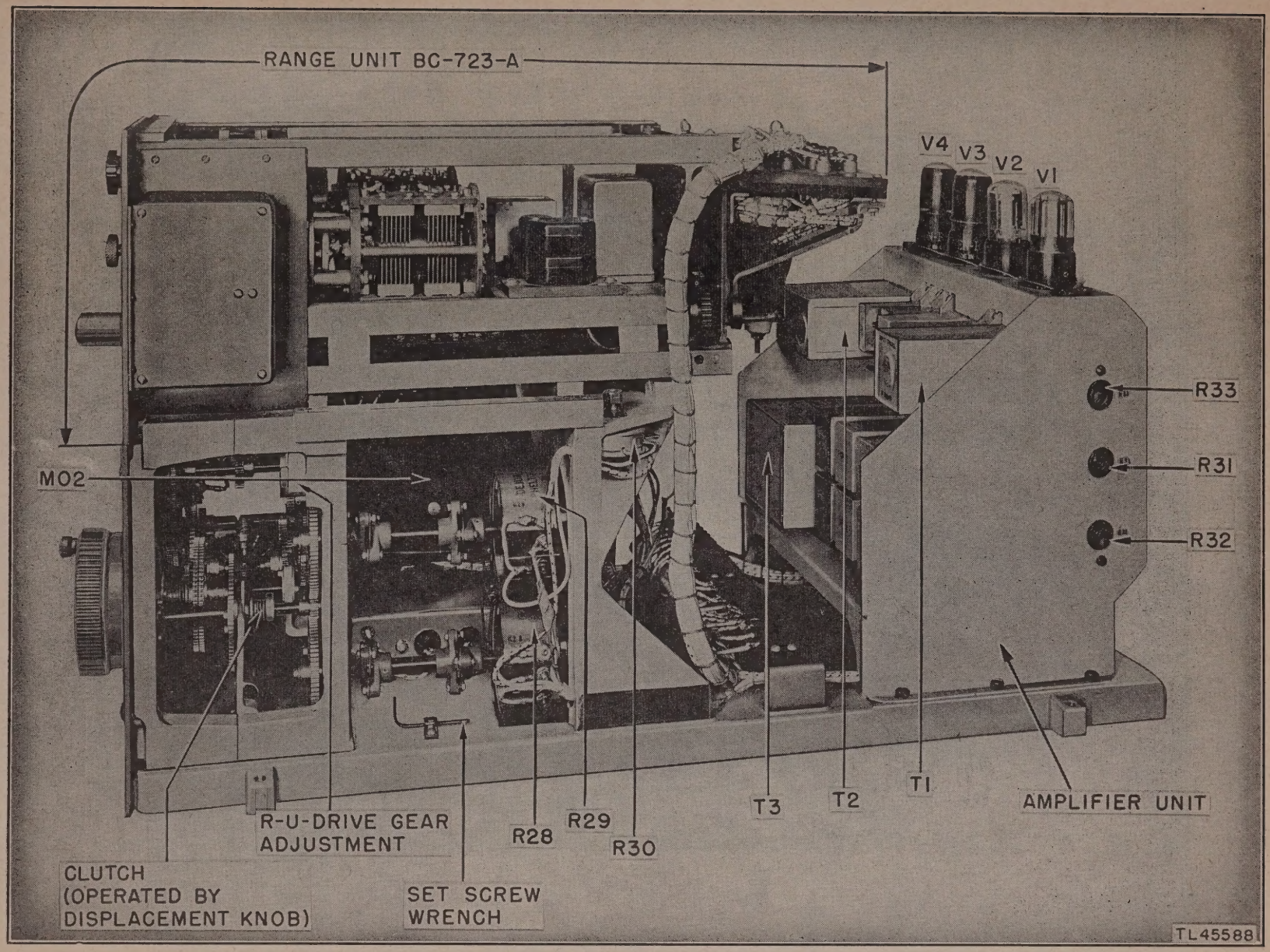

Figure 3. Combined Range Unit BC-723-A and Control Unit BC-1296-A, right side view of chassis.

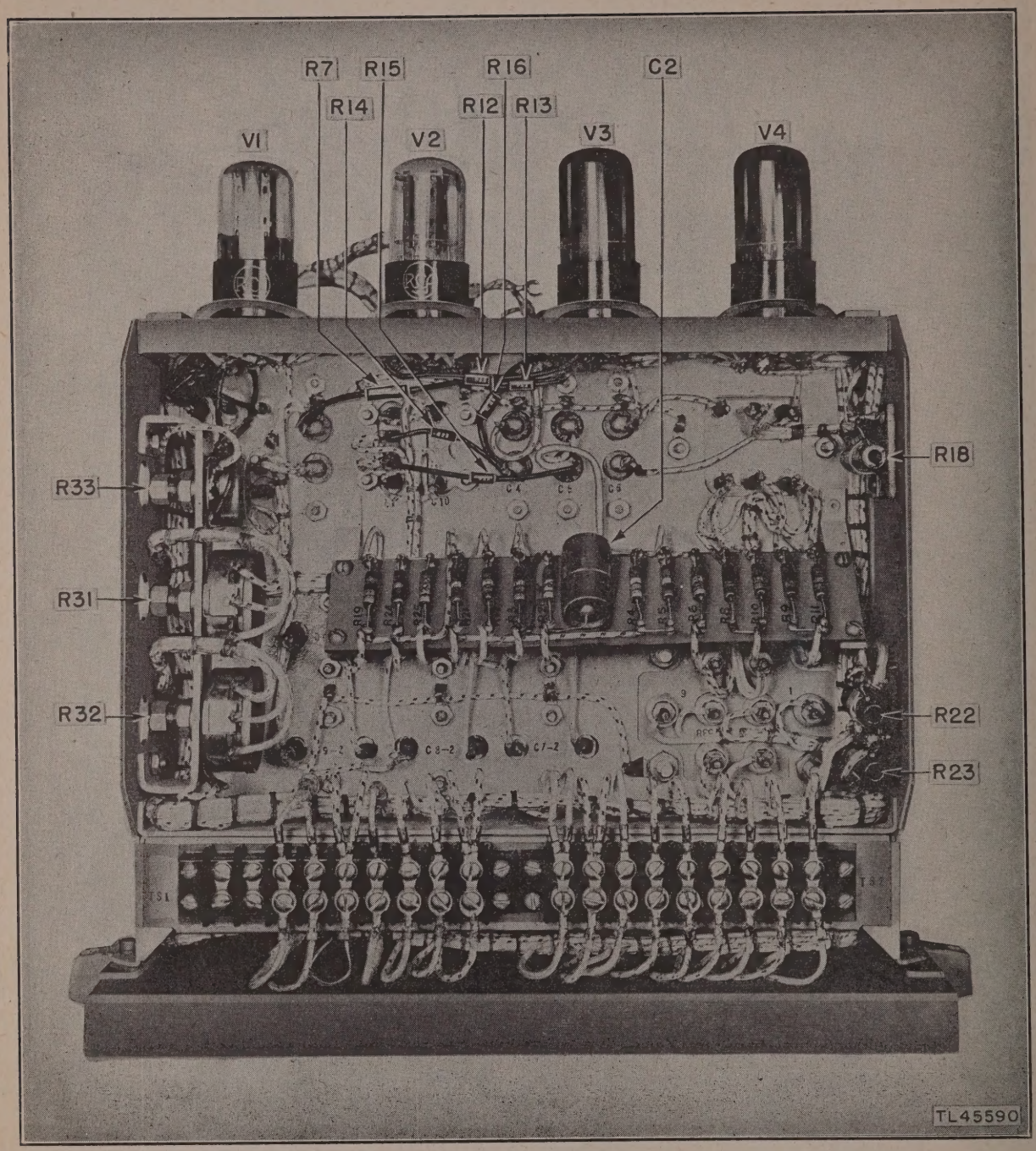

Figure 4. Control Unit BC-1296-A, rear view of amplifier chassis.

SECTION II

INSTALLATION AND OPERATION

3. INSTALLATION PROCEDURE.

The procedure for installing Range Aided Tracking and Data Transmitter Kit A96–U1 on Radio Set SCR–296–A is completely outlined below.

CAUTION: Disconnect all power from the indicating equipment table before starting the installation.

a. Disconnect the external wiring and remove Range Unit BC–723–A from the table. To facilitate identification, label each wire with the number of the terminal from which it was removed.

b. Discard the base and cover of the range unit and modify the chassis as follows (fig. 5):

(1) Remove and discard the cover of the vernier dial box after detaching the lamp socket from the cover. Retain all screws and washers for re-use.

(2) Remove and discard the handwheel.

(3) Remove and discard the brackets supporting the heater unit and the stand-off insulators. Do not disconnect the wiring, since the heater unit and the stand-off insulators are to be used again. Retain all screws and washers for re-use as required.

(4) Attach the lamp socket to the cover assembly (item 23) and install the cover assembly, using the salvaged screws and washers.

(5) Install the sleeve assembly (item 20).

(6) Install the existing stand-off insulators in the new positions indicated, using the salvaged screws and washers, plus items 26 and 28.

(7) Install the clamp assembly (item 21) loosely on the heater unit and secure it under the existing nut and washers as indicated.

(8) Install the clamp assembly (item 22) loosely on the heater unit and secure it as indicated with the screw (item 27) which replaces the existing screw. The existing washers are to be re-used.

(9) Position the heater unit approximately as indicated and tighten the clamp assembly screws.

(10) The modification parts required in accordance with the preceding instructions are supplied in duplicate to permit modification of the spare range unit.

c. Provide the 115-volt, 60-cycle power circuit for the new control unit by running two No. 14 wires (item 16) from terminals Nos. 1 and 2 of Range Oscilloscope BC–719–A through the table wiring duct and conduit No. 59. These wires must be equipped with spade terminals (item 17) at both ends.

d. The new wiring required for connection to the data transmitter may be run to the control unit through conduit No. 60. This wire is not supplied as part of Kit A96–U1.

e. Install the control unit (item 12) on the table in the position formerly occupied by the range unit. The clearance holes in the base of this unit for conduits Nos. 59 and 60 will serve to locate the unit on the table. Only one control unit is required for operation of the equipment. The second unit (item 13) is a spare.

f. Secure the control unit to the table with wood screws and washers (items 29, 30, and 31) as shown in figure 6. To provide access to the mounting hole located between the conduit openings, the amplifier subassembly on the control unit may be loosened and tilted to the rear without disconnecting the associated wiring.

g. Connect the external wiring (disconnected in accordance with subparagraph (1) above) and the power circuit wiring (indicated in subparagraph (3) above) to the terminal strips of the control unit as shown in figure 7.

h. Loosen the lock screw on the coupling gear adjustment lever and remove the hold-down screws and lugs.

i. Place the modified range unit in position on top of the control unit with the front panels in alignment. Be sure to mesh the gears of the two units during this operation.

j. Secure the range unit in position with the hold-down lugs. Tighten the wedge-type lugs first, in order to seat the range unit firmly against the locating shoulder provided on the control unit.

k. Adjust the coupling gear for smooth operation without backlash and tighten the lockscrew.

l. Terminate the local cable provided with the control unit at the terminal strip of the range unit, as indicated in figure 7, and place the cover over the combined assembly.

4. OPERATION.

a. When the power is turned on to Radio Set SCR–296–A in the normal manner, all of the circuits of Control Unit BC–1296–A are energized, and the standby heaters are disconnected.

b. Before the installation of the control unit, the only operating control of the range position was the range unit handwheel, which changed the range by 2,000 yards for each rotation. After the installation of Control Unit BC–1296–A the control unit handwheel replaces the range unit handwheel as the operating control in range. The range unit operation and the resulting signal motion on the screen of the range oscilloscope is the sum of the effects of two causes: (1) the operation of the motor MO1 in the control unit, which rotates the range unit capacitors and dials at a rate of zero to 50 yards per second, this rate being determined by the position of the control unit handwheel over a range of ± 10 rotations; and (2) the rotation of the handwheel directly which, in addition to its rate changing function, adds or subtracts linear displacement in range at 200 yards per rotation. If the handwheel is turned beyond the approximately ± 10 rotations mentioned, no further rate change takes place, but the 200 yards per rotation displacement continues.

c. If it is desired to maintain an existing rate and to use the handwheel for adding displacement only, depress (and lock, if desired) the DISPLACEMENT knob. Accordingly, if it is desired to lock out the "aided tracking" feature, adjust the handwheel to give zero tracking rate, and lock in the DISPLACEMENT knob. The range may be slewed at 1,000 yards per second by operating the SLEW switch to INCREASE or DECREASE as required. This switch is nonlocking in either position.

d. The associated range data potentiometer operates at 200 yards per rotation and may be used to supply range data over suitable circuits to a distant point.

g. Connect the external wiring (disconnected in accordance with subparagraph (1) above) and the power circuit wiring (indicated in subparagraph (3) above) to the terminal strips of the control unit as shown in figure 7.

h. Loosen the lock screw on the coupling gear adjustment lever and remove the hold-down screws and lugs.

i. Place the modified range unit in position on top of the control unit with the front panels in alignment. Be sure to mesh the gears of the two units during this operation.

j. Secure the range unit in position with the hold-down lugs. Tighten the wedge-type lugs first, in order to seat the range unit firmly against the locating shoulder provided on the control unit.

k. Adjust the coupling gear for smooth operation without backlash and tighten the lockscrew.

l. Terminate the local cable provided with the control unit at the terminal strip of the range unit, as indicated in figure 7, and place the cover over the combined assembly.

4. OPERATION.

a. When the power is turned on to Radio Set SCR–296–A in the normal manner, all of the circuits of Control Unit BC–1296–A are energized, and the standby heaters are disconnected.

b. Before the installation of the control unit, the only operating control of the range position was the range unit handwheel, which changed the range by 2,000 yards for each rotation. After the installation of Control Unit BC–1296–A the control unit handwheel replaces the range unit handwheel as the operating control in range. The range unit operation and the resulting signal motion on the screen of the range oscilloscope is the sum of the effects of two causes: (1) the operation of the motor MO1 in the control unit, which rotates the range unit capacitors and dials at a rate of zero to 50 yards per second, this rate being determined by the position of the control unit handwheel over a range of ± 10 rotations; and (2) the rotation of the handwheel directly which, in addition to its rate changing function, adds or subtracts linear displacement in range at 200 yards per rotation. If the handwheel is turned beyond the approximately ± 10 rotations mentioned, no further rate change takes place, but the 200 yards per rotation displacement continues.

c. If it is desired to maintain an existing rate and to use the handwheel for adding displacement only, depress (and lock, if desired) the DISPLACEMENT knob. Accordingly, if it is desired to lock out the "aided tracking" feature, adjust the handwheel to give zero tracking rate, and lock in the DISPLACEMENT knob. The range may be slewed at 1,000 yards per second by operating the SLEW switch to INCREASE or DECREASE as required. This switch is nonlocking in either position.

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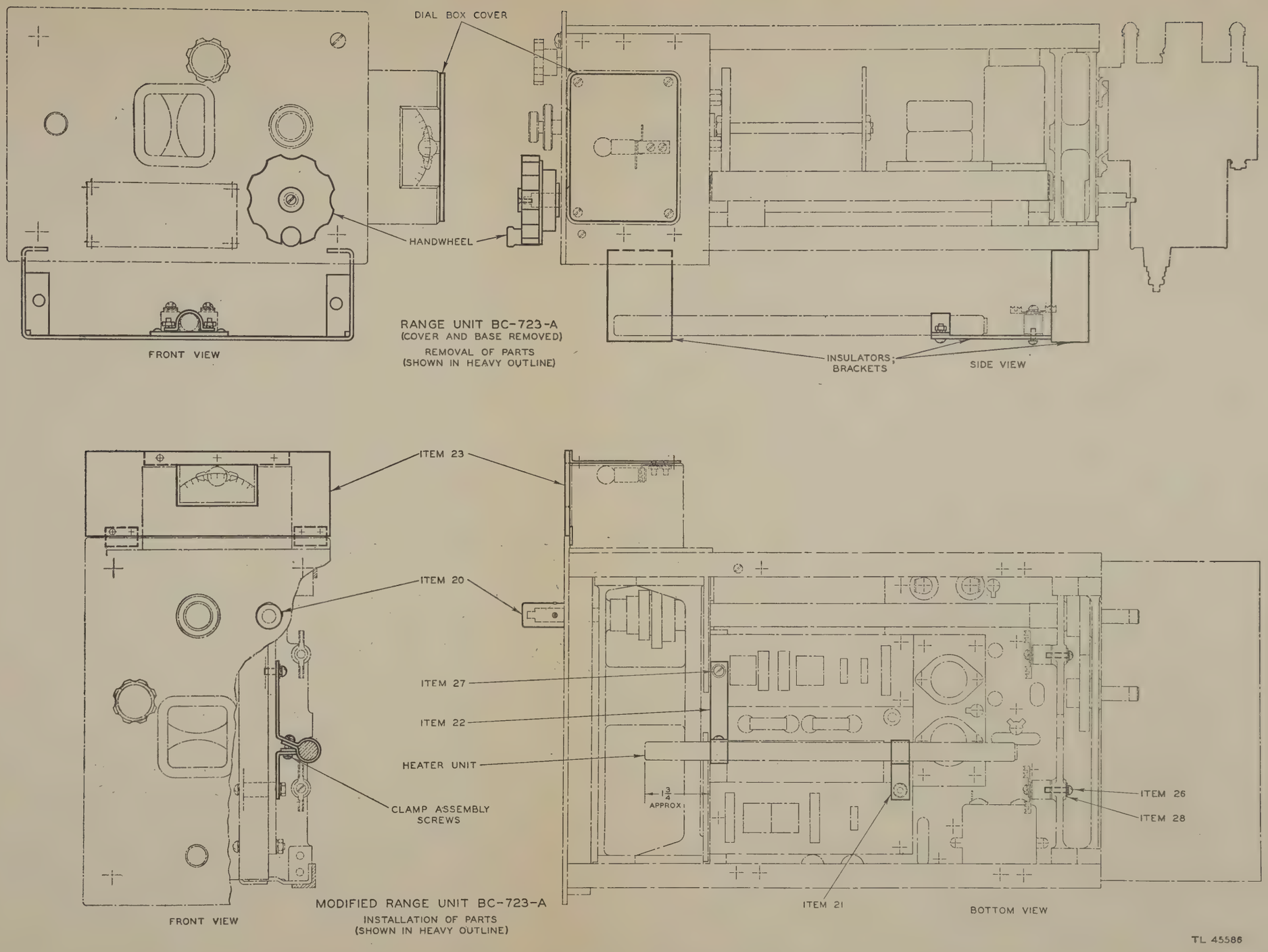


Figure 5. Modification of Range Unit BC-723-A.

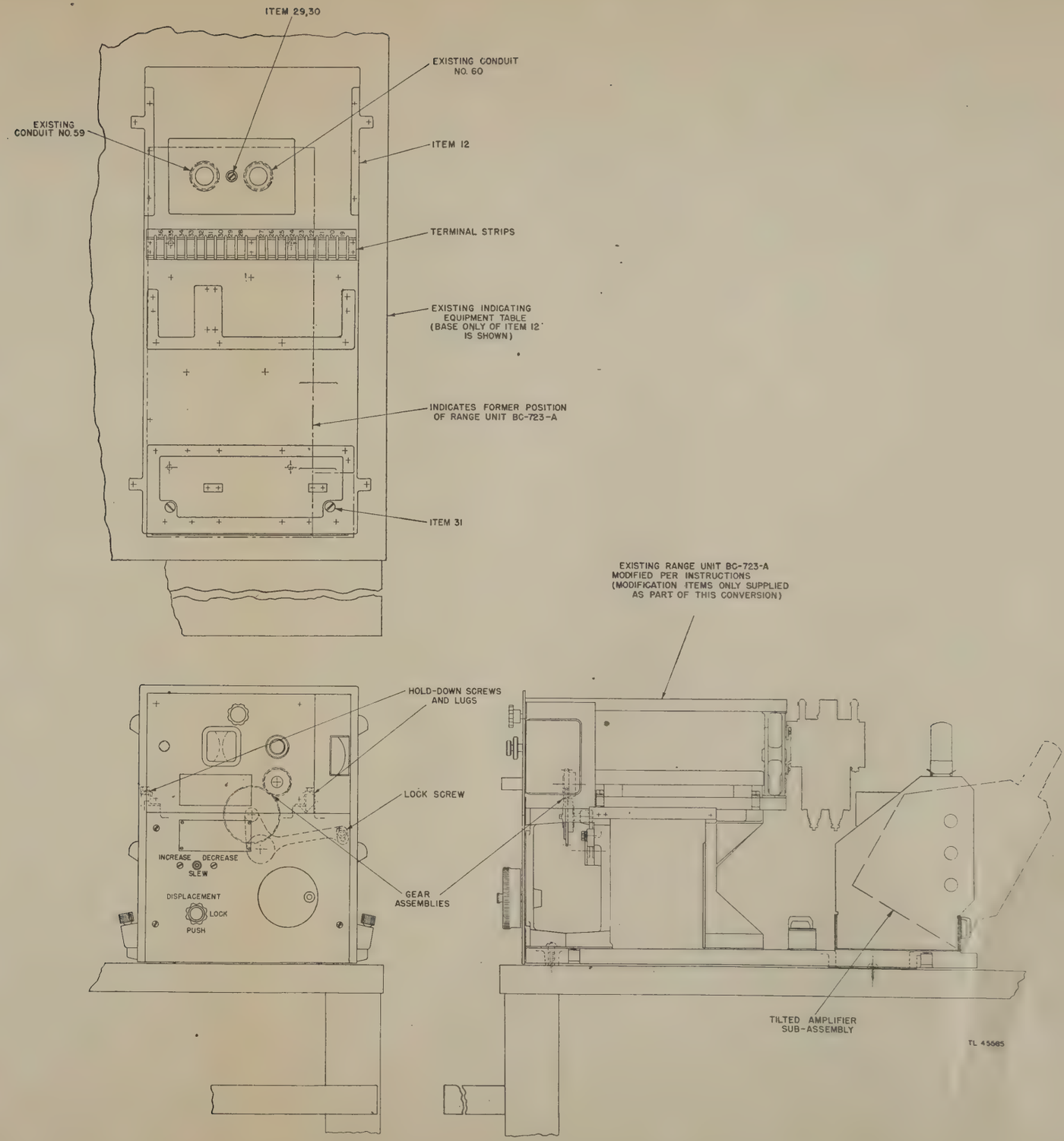
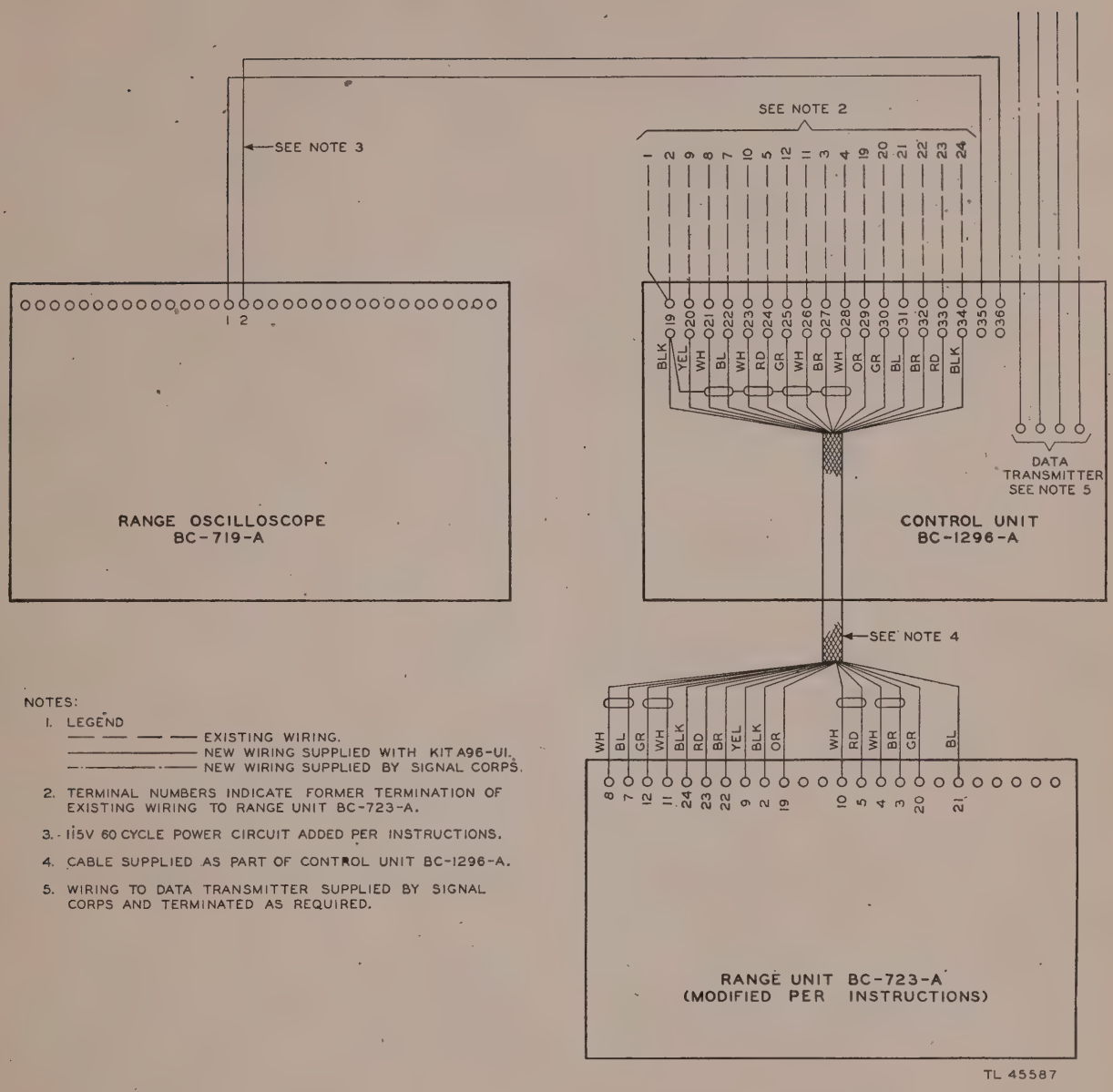

ITEM 29,30
EXISTING CONDUIT NO. 60
EXISTING CONDUIT NO. 59
ITEM 12
TERMINAL STRIPS
EXISTING INDICATING EQUIPMENT TABLE (BASE ONLY OF ITEM 12 IS SHOWN)
INDICATES FORMER POSITION OF RANGE UNIT BC-723-A
ITEM 31
EXISTING RANGE UNIT BC-723-A MODIFIED PER INSTRUCTIONS (MODIFICATION ITEMS ONLY SUPPLIED AS PART OF THIS CONVERSION)
HOLD-DOWN SCREWS AND LUGS
LOCK SCREW
INCREASE DECREASE SLEW
DISPLACEMENT LOCK PUSH
GEAR ASSEMBLIES
TILTED AMPLIFIER SUB-ASSEMBLY
TL 45585

Figure 6. Conversion details for installation of Kit A96–U1.



NOTES:

1. LEGEND
   - — — — — EXISTING WIRING.
   - ——————— NEW WIRING SUPPLIED WITH KIT A96-UI.
   - —·———·— NEW WIRING SUPPLIED BY SIGNAL CORPS.
2. TERMINAL NUMBERS INDICATE FORMER TERMINATION OF EXISTING WIRING TO RANGE UNIT BC-723-A.
3. 115V 60 CYCLE POWER CIRCUIT ADDED PER INSTRUCTIONS.
4. CABLE SUPPLIED AS PART OF CONTROL UNIT BC-1296-A.
5. WIRING TO DATA TRANSMITTER SUPPLIED BY SIGNAL CORPS AND TERMINATED AS REQUIRED.

Figure 7. Wiring modifications to include Control Unit BC–1296–A.

SECTION III

FUNCTIONING OF PARTS

5. CIRCUIT AND MECHANISM.

a. In Control Unit BC–1296–A the tracking rate is controlled by an electromagnetic system in which the speed of the tracking drive motor is governed accurately by a potentiometer, this speed being effectively independent of the small load variations which may occur. The schematic diagram of the control system is shown in figure 8. The tracking drive motor, MO1, is of the reversible type in which the fixed field is excited from the 60-cycle power source and the control field receives its excitation from an amplifier. The output of the amplifier is controlled by a rate control potentiometer (combination of R28 and R29) which derives voltage from the same source as the fixed field. In addition to driving the range unit through appropriate reduction gearing, the motor also drives a generator, G1, the output of which is connected to the input of the amplifier. This generator voltage is in phase opposition to the voltage obtained from the control potentiometer, which always exceeds the generator voltage in magnitude, except when both are zero.

b. In figure 9, the curve marked "R29 slider voltage" is the characteristic curve of the rate potentiometer voltage as applied between terminals Nos. 6 and 5. This characteristic curve is obtained from the design of the potentiometer combination R28 and R29. This potentiometer combination is so designed that its output voltage is approximately linear with respect to the motor speed or rate (fig. 9). The voltage at the amplifier input is the potentiometer voltage less the generator voltage.

c. The amplifier (from vacuum tube V1 through transformer T2) supplies the control winding of drive motor MO1, which drives generator G1 directly and drives the range unit through gearing. The output of the generator is returned to the input of the amplifier through the transformer T1 and phase correcting network C1-R33-R1 (fig. 8), the function of which is to adjust the generator voltage to exact phase opposition with the potentiometer voltage. The output voltage from the potentiometers R28 and R29, which are controlled by the handwheel regulating the rate, is also fed to the input of the amplifier in series with the secondary of the transformer T1. The control R30 adjusts the range of the speed covered by the two potentiometers which are under control of the handwheel. The network R22-R23-C7-C8-C9 is for the purpose of shifting the phase of the voltage supplied to the rate control potentiometer so that the voltage appearing at the control winding of the drive motor is displaced 90° in phase from the voltage supplied to the fixed winding.

d. Controls R32 and R31 are balancing potentiometers used to neutralize the effect of leakage voltage between the exciting and output windings of the generator. These controls and also the control R30 when once set require no further adjustment except when major equipment components, such as the generator or motor, are replaced.

e. As the power supply and also the voltage from the generator may have high third harmonic content, the network L1-C10 is used to reduce the system gain at 180 cps. The amplifier output voltage is a linear amplified reproduction of the input voltage and is applied to the control winding of the motor. The potentiometer voltage, the motor speed, and the generator voltage have an approximately linear relationship.

f. Any handwheel setting other than that corresponding to zero rate causes a potentiometer voltage at the amplifier input, with a resulting voltage across the control winding of the motor. This voltage has a plus or minus 90° phase relationship with the voltage across the fixed field. The motor rotates in one direction if the phase relationship is plus, and in the other direction if it is minus. The resulting generator voltage begins at once to reduce the amplifier input voltage, and, when the motor speed reaches a point where the amplifier input voltage is just sufficient to maintain it at that speed, no further change occurs. This balance speed is reached almost instantly. Thus, any tendency of the motor to deviate from the speed associated with the circuit balance for a given potentiometer setting results in a voltage change, at the motor terminals, of such amplitude and polarity as to return the motor to the balance speed.

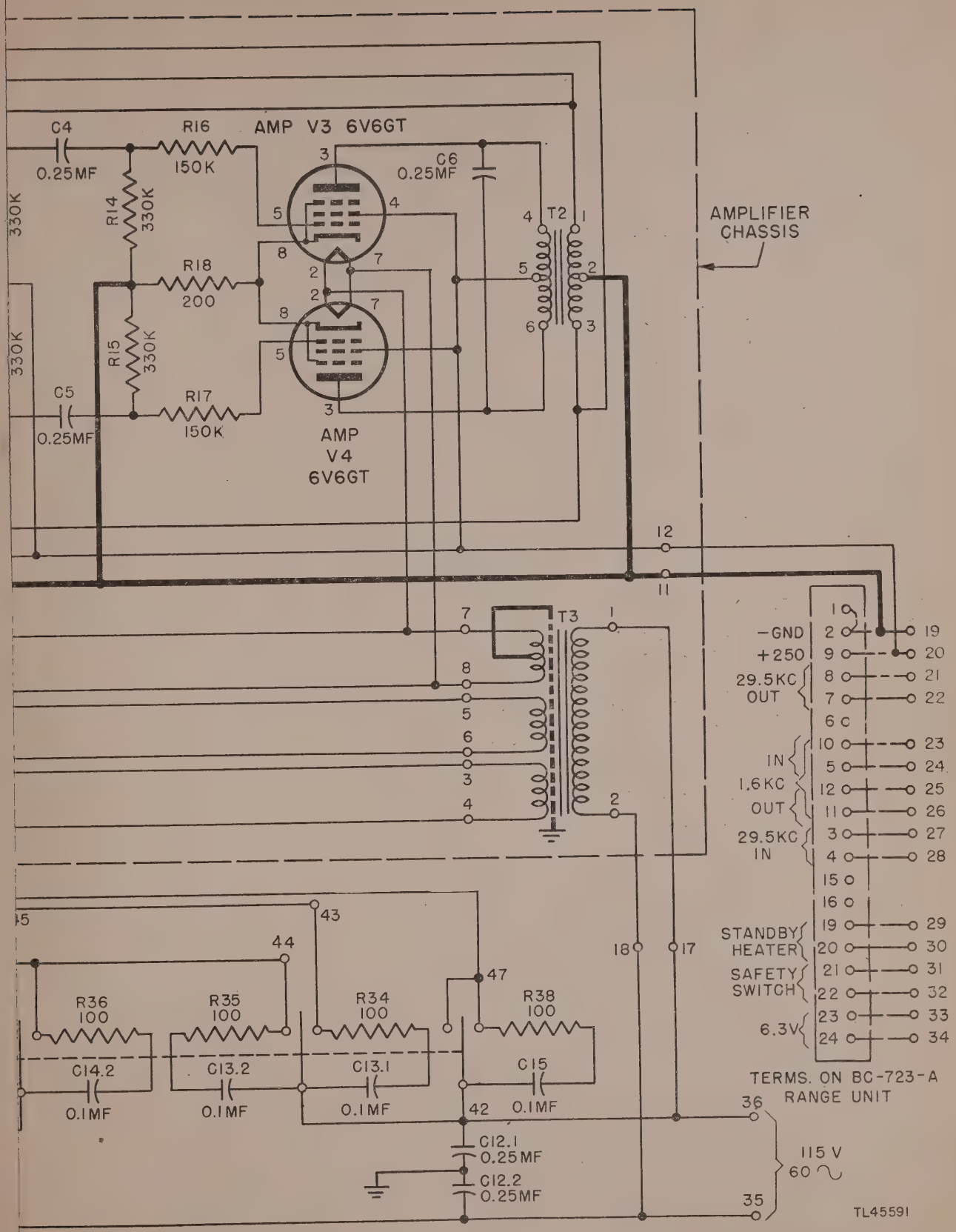
g. For a given handwheel setting, the motor voltage may vary considerably depending upon the load, bearing friction, etc. However, the speed is held with narrow limits and nearly linear with the potentiometer voltage by the action described above.

h. The feedback system permits a motor speed range as great as 100 to 1, without appreciable variation under the small load changes in this application.

i. All three stages in the amplifier are push-pull resistance coupled. Stage V1 is a phase inverter stage to couple its single input to the push-pull circuit.

j. The range unit and the data potentiometer drive gears are mechanically connected to the driven member of a differential, the two driving members of which are mechanically connected to the drive motor and the handwheel, respectively, as shown in figure 10. Thus the handwheel adds displacement at 200 yards per revolution in either direction to the motion of the driven member and to the range setting and data. In addition, the handwheel is geared to the rate control potentiometers through a slip clutch, which may be disengaged by depressing the DISPLACEMENT knob. The potentiometers control the tracking rate for about ±10 revolutions of the handwheel from the zero rate position. If the handwheel is turned farther the clutch slips, permitting displacement at 200 yards per turn but with no additional rate change.

k. Slewing is accomplished by means of an auxiliary motor, MO2, which is geared to the motor driven member of the differential. The slewing motor is of the reversible induction type operated by a three-position, self-restoring switch, which is normally off. Operating the switch in one direction from the off position causes the range to increase at approximately 1,000 yards per second; and throwing the switch in the opposite direction causes the range to decrease at a similar rate. A slip clutch is incorporated in the reduction gear train between the differential and the tracking drive motor to prevent the reduction gear and the tracking motor from being driven at excessive speeds during the slewing operation. No mechanical braking is required to operate the clutch as the motor resists being driven at any speed other than the one governed by the setting of the rate control potentiometer. The action of the drive motor also brakes the slewing motor when the SLEW switch is released, thereby minimizing overshoot. A drag, or brake, on the handwheel shaft prevents spinning of the handwheel during slewing, which spinning results from torque transmitted to the handwheel through the differential.


C4
0.25MF
R16
150K
AMP V3 6V6GT
C6
0.25MF
330K
R14
330K
R18
200
330K
R15
330K
C5
0.25MF
R17
150K
AMP
V4
6V6GT
T2
AMPLIFIER
CHASSIS
T3
-GND
+250
29.5KC
OUT
IN
1.6KC
OUT
29.5KC
IN
STANDBY
HEATER
SAFETY
SWITCH
6.3V
TERMS. ON BC-723-A
RANGE UNIT
R36
100
R35
100
R34
100
R38
100
C14.2
0.1MF
C13.2
0.1MF
C13.1
0.1MF
C15
0.1MF
C12.1
0.25MF
C12.2
0.25MF
115 V
60
TL45591

f. Any handwheel setting other than that corresponding to zero rate causes a potentiometer voltage at the amplifier input, with a resulting voltage across the control winding of the motor. This voltage has a plus or minus 90° phase relationship with the voltage across the fixed field. The motor rotates in one direction if the phase relationship is plus, and in the other direction if it is minus. The resulting generator voltage begins at once to reduce the amplifier input voltage, and, when the motor speed reaches a point where the amplifier input voltage is just sufficient to maintain it at that speed, no further change occurs. This balance speed is reached almost instantly. Thus, any tendency of the motor to deviate from the speed associated with the circuit balance for a given potentiometer setting results in a voltage change, at the motor terminals, of such amplitude and polarity as to return the motor to the balance speed.

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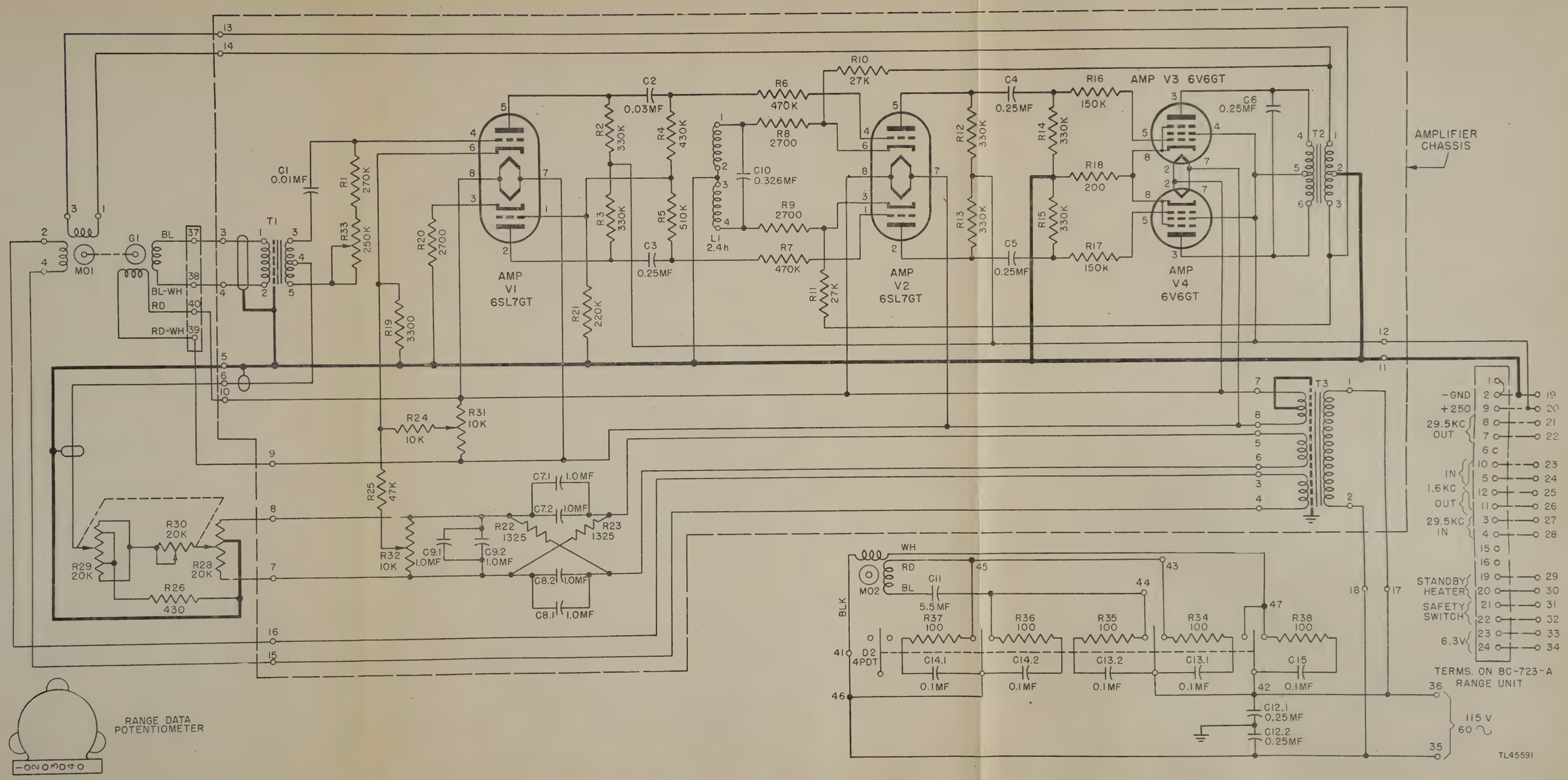

Figure 8. Control Unit BC–1296–A, schematic diagram.

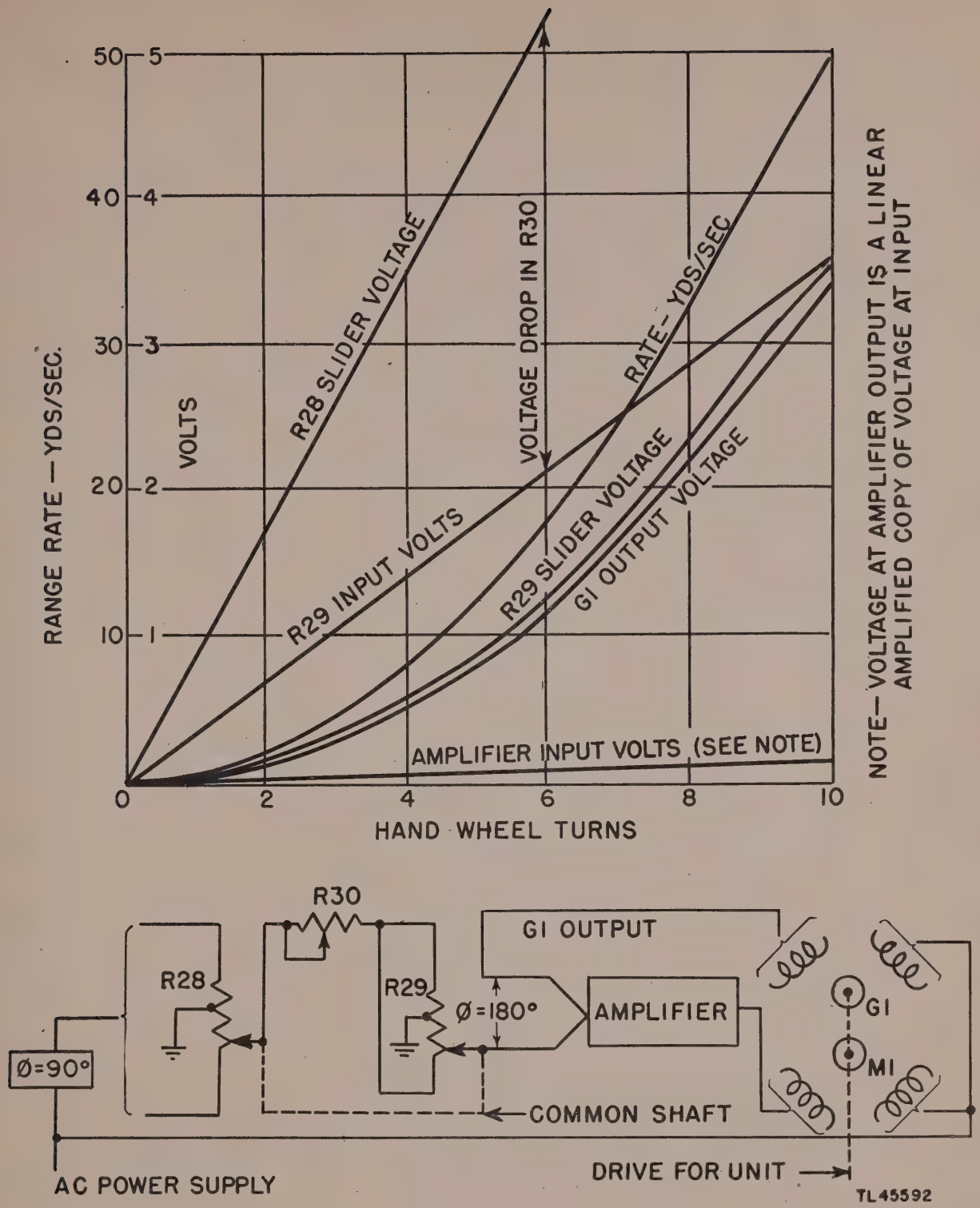

Figure 9. Control Unit BC–1296–A, explanatory diagram and characteristic curves.

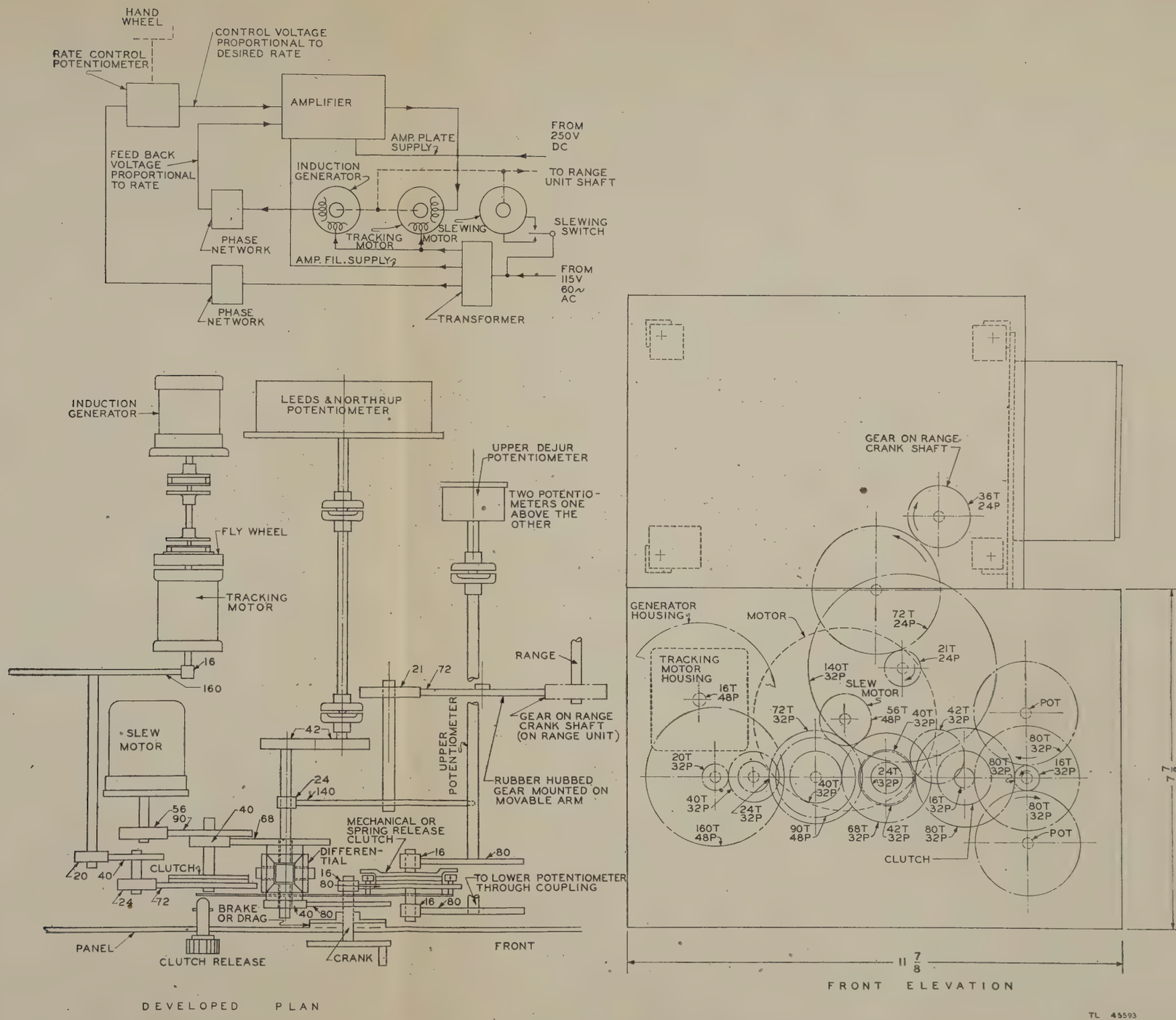

Figure 10. Control Unit BC–1296–A, block diagram of gearing and electrical circuit.

SECTION IV

MAINTENANCE

6. VOLTAGE AND RESISTANCE TABLES.

The important voltage and resistance measurements are given in the following tables. Circuit voltage and resistance readings are taken from the main terminal strips, TS3 and TS4, in the center of the control unit (fig. 11). Tube socket voltage and resistance readings are taken from the pins of the tube sockets to ground, as indicated in the tables. Before taking any measurements, refer to the notes under each table for detailed information.

CAUTION: When taking resistance measurements all power to the control unit must be shut off.

7. ADJUSTMENTS.

If it is necessary to replace motor MO1, generator G1, or parts of the balancing networks comprising C1-R1-R33, R24-R31, and R25-R32 (figs. 3 and 8), or if the balancing controls are thought to be out of adjustment, proceed as follows:

a. Adjust the couplings to the shafts of R28 and R29 so that the sliders of both potentiometers reach the end of the travel simultaneously.

b. Set R30, R31, and R32 at approximately midposition.

c. Apply power to the unit and allow a warm-up period of at least five minutes.

d. Connect any type of voltmeter capable of reading 100 volts, 60 cycles a-c across terminals Nos. 13 and 14 of the amplifier chassis. Rotate the handwheel until R28 and R29 have assumed one extreme position and adjust R33 for minimum reading of the voltmeter. Rotate the handwheel until R28 and R29 have assumed the other extreme position and readjust R33 for minimum reading of the voltmeter. These operations should be repeated several times until the best over-all adjustment of R33 is obtained.

e. Set R28 and R29 to midposition as indicated by minimum voltage across terminals Nos. 5 and 6 of the amplifier chassis. This voltage should be read with a high resistance a-c voltmeter, preferably of the Ballentyne type, or with a cathode-ray oscilloscope. After R28 and R29 are set, short-circuit terminals 5 and 6 and the motor will revolve slowly.

f. With the motor restrained from rotation, adjust R31 and R32 alternately for minimum voltage across terminals 13 and 14. Remove the brake from the motor, which now may or may not revolve. If the motor revolves, readjust R31 and R32 slightly until it stops. Meanwhile, obtain approximately the same minimum voltage across terminals 13 and 14.

g. Remove the short circuit from terminals 5 and 6 and rotate R28 and R29 to one extreme position. Readjust R33 for minimum voltage across terminals 13 and 14. Adjust R30 to make the tracking rate approximately 50 yards per second for either extreme position of R28 and R29.

h. As the various adjustments are interdependent to some extent, those outlined in subparagraphs **e**, **f**, and **g** should be repeated.

8. LUBRICATION.

Periodically, the cover is removed from the combined range and control unit and the rotating parts are lubricated with the following lubricant: Oil, Lubricating, Preservative, Special, U. S. Army Spec. No. 2-120. Lubricating instructions are as follows:

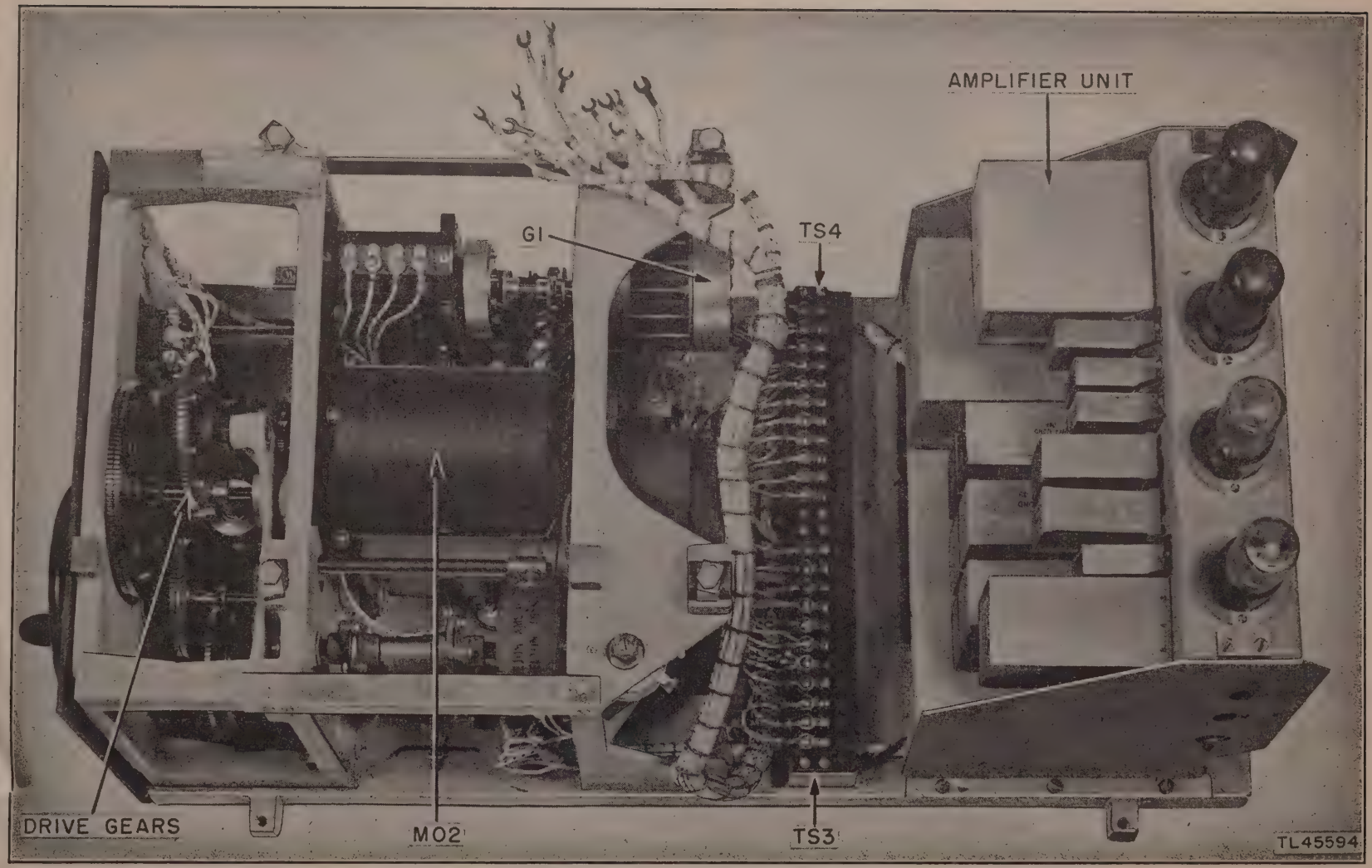

Figure 11. Control Unit BC–1296–A, top view of chassis.

TABLE I

CIRCUIT AND TUBE SOCKET VOLTAGES

Circuit Voltages (A-C)

Terminal to Terminal		*Volts*	*Notes*
7	Gnd	12.5	(1)
8	Gnd	12.5	(1)
7	8	25	(1)
9	Gnd	3.2	(2)
10	Gnd	3.2	(2)
9	10	6.4	(2)
13	Gnd	20	(3)
14	Gnd	20	(3)
13	14	40	(3)
15	Gnd	0	(4)
16	Gnd	0	(4)
15	16	75	(4)

Tube Socket Voltages to Ground (D-C)

TUBE		PIN NUMBER							
Symbol	Type	1	2	3	4	5	6	7	8
V1	6SL7GT	0	100	1	0	100	1	*	*
V2	6SL7GT	0	120	1	0	120	1	*	*
V3	6V6GT	0	*	245	250	0	–	*	20
V4	6V6GT	0	*	245	250	0	–	*	20

* Indicates filament pins (3.2 volts a-c to ground).

NOTES:

(1) Handwheel excitation voltage; this should be approximately 90° phase difference with respect to a-c voltage, as determined with oscilloscope.

(2) Generator excitation voltage; this should be in phase with the line voltage, and balanced to ground.

(3) Motor excitation voltage; this should be in phase with the line voltage, and ungrounded.

(4) Amplifier output voltage to motor; this will be fluctuating and of irregular waveform; voltages given are approximate for low tracking rates and may be increased slightly at higher rates; voltages will jump when rate is changed suddenly by turning rate handwheel; with handwheel set for high rates, braking motor by finger on flywheel should cause voltages to approximately double, and to approach sine wave form at 90° difference from supply voltage.

(5) All voltages measured with normal supply voltages, viz.: 115-volt, 60-cycle a-c on terminals 17 to 18, and 39 to 40; and 250-volt d-c on terminals 11 to 12, and 23 to 24.

TABLE II

CIRCUIT AND TUBE SOCKET RESISTANCES

Circuit Resistances

Terminal to Terminal		*Resistance (ohms)*	*Note*
3 or 4	Gnd	Inf*	
3	4	2	
5	Gnd	0	
6	Gnd	600	(1)
6	Gnd	330	(2)
6	Gnd	5,000	(3)
7 or 8	Gnd	600	
7	8	950	
9 or 10	Gnd	0	
9	10	0	
11	Gnd	0	
12	Gnd	Inf	
13 or 14	Gnd	10	
13	14	20	
15 or 16	Gnd	Inf	
15	16	20	

* Infinity.

Tube Socket Resistances to Ground

TUBE		PIN NUMBER								Note
Symbol	Type	1	2	3	4	5	6	7	8	
V1	6SL7GT	220K	Inf	2,700	400K	Inf	2,700	0	0	(4)
V1	6SL7GT	220K	270K	2,700	400K	270K	2,700	0	0	(5)
V2	6SL7GT	1.1 meg	Inf	2,700	1.1 meg	Inf	2,700	0	0	(4)
V2	6SL7GT	1.1 meg	270K	2,700	1.1 meg	270K	2,700	0	0	(5)
V3	6V6GT	0	0	Inf	Inf	500K	–	0	200	(4)
or V4	6V6GT	0	0	125	0	500K	–	0	200	(5)

NOTES:

(1) At handwheel position for zero tracking rate.

(2) Minimum values found at approximately one-half handwheel turn from zero rate position in either direction.

(3) For maximum rate positions of handwheel.

(4) With wiring removed from terminals 11 and 12.

(5) With terminals 11 and 12 shorted.

a. In nontropical locations, lubricate all rotating parts once each month.

b. In tropical locations, lubricate all rotating parts once each week. Do not over-lubricate.

NOTE: If a War Department Lubrication Order is attached to the equipment, disregard the above information, and follow the instructions outlined on the lubrication order.

9. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment requires special attention in tropical areas where temperature and relative humidity are extremely high. Following are typical problems which may be encountered in operation:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail.

(2) Electrolytic action takes place in resistors, coils, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant lacquer applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the lacquer-spray method of moistureproofing and fungiproofing.

CAUTION: Lacquer spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over the nose and mouth.

c. Step-by-step Instructions for Treating Control Unit BC–1296–A.

(1) PREPARATION.

(*a*) Make all repairs and adjustments necessary for proper operation of the equipment.

(*b*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(2) DISASSEMBLY.

(*a*) Remove the 3 bolts and nuts from around the edges of the potentiometer housing on Control Unit BC–1296–A.

(*b*) Remove the potentiometer from the unit.

(*c*) Replace the nuts and bolts on the unit.

(*d*) Remove the 3 screws from the front cover of the potentiometer housing.

(*e*) Remove the cover from the potentiometer housing.

(*f*) Remove the contact arm from the potentiometer.

(*g*) Remove the 6 screws that hold the phenolic disk to the potentiometer housing.

(h) Remove the disk from the housing.

CAUTION: Handle the disk carefully when removing it.

(3) MASKING (fig. 12).

(*a*) Mask the moving parts of the three potentiometers on the underside of the amplifier chassis.

(*b*) Mask the 4 octal tube sockets on the underside of the chassis.

(4) DRYING.

Dry the control unit for 6 hours at 140° F.

(5) VARNISHING.

(*a*) Apply three coats of Lacquer, Fungus-resistant, Spec. No. 71-2202 (stock No. 6G1005.3), or equal, to the unit.

(*b*) Brush-coat all resistors, phenolic materials, and the wiring of the potentiometer.

CAUTION: Keep the lacquer off the potentiometer.

(*c*) Brush-coat all textile-insulated wiring, terminal boards, and phenolic materials in the compartments behind the front panel of the control unit.

(*d*) Spray the underside of the amplifier chassis.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Reassemble the set, and test its operation.

(7) MARKING.

Mark the set with "MFP" and the date of the treatment. Example: MFP—4 June 1944.

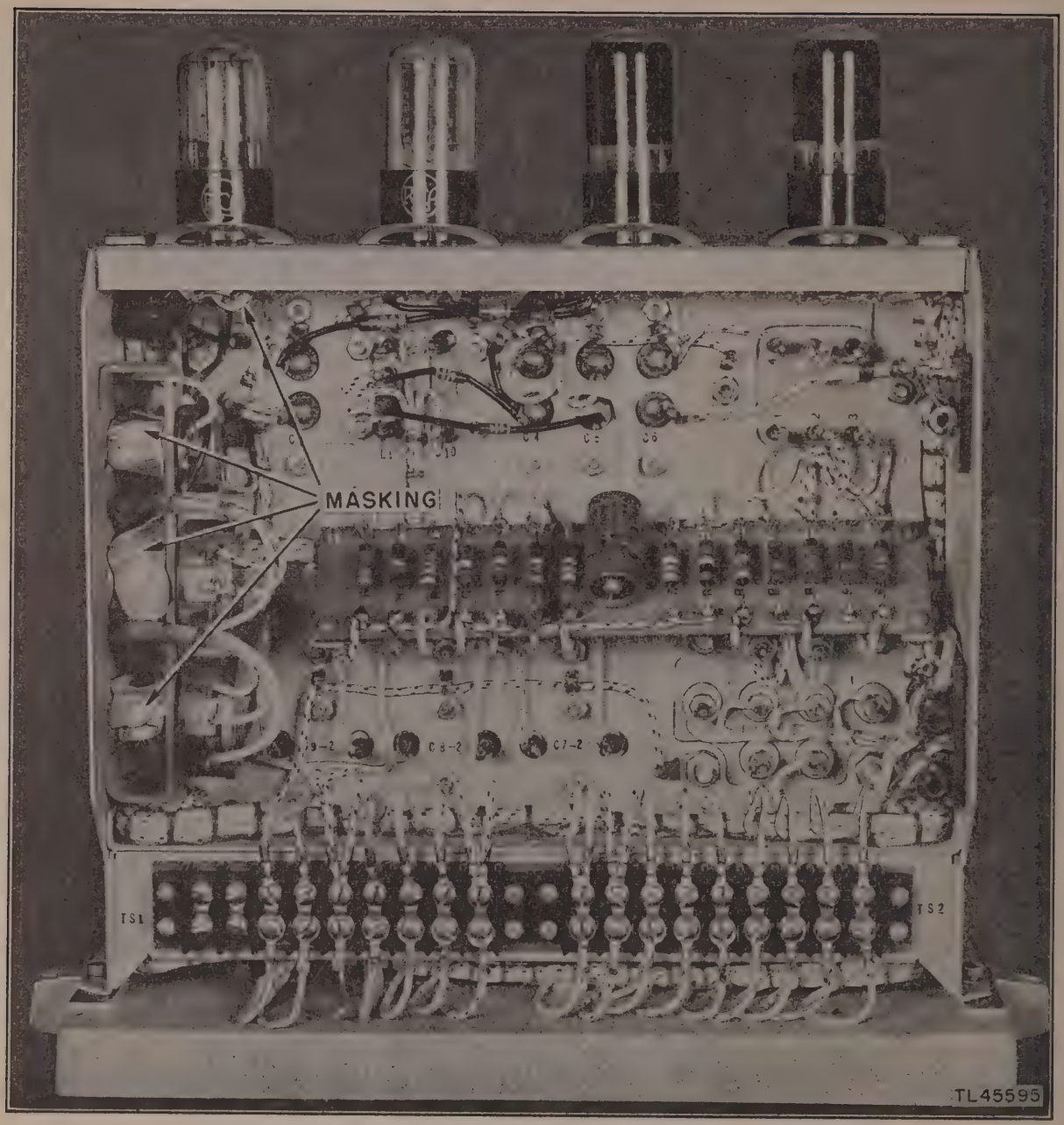

Figure 12. Control Unit BC–1296–A, rear view of amplifier chassis showing masking details.

10. MAINTENANCE PARTS LIST FOR KIT A96–U1.

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock		3d ech	4th ech	Depot stock
					1st ech	2d ech			
.001 to .1700 not used .1701	3C1987-03		COIL: retardation; 2.4 henrys ±1%; terminals 1 and 4 with 2 connected to 3; effective resistance 409 ohms; requirements for inductance and effective resistance shall be met using 10 volts.				*	*	*
.1702	3H2467-4		GENERATOR: K8-9373 (similar to K8-8624 motor except for change in rotary cup material, dimensions of mounting boss, and shaft extension).				*	*	*
.1703	3H3000SR		MOTOR: 75v; 60 cycle; 0.11 amp; 2 phase; 2 pole; 3200 rpm.				*	*	*
.1704	3H3000A03-3		MOTOR: capacitor; 1/40 hp; 115v; 60 cycle; single-phase; 1,725 rpm; 3 terminal; reversible.				*	*	*
.1705	2Z8678.16		SOCKET: vacuum tube; Octal.			*	*	*	*
.1706	2Z9849.126		SWITCH: SPDT; normally open; spring return; with luminous top.				*	*	*
.1707	2Z9613.304		TRANSFORMER: 37.95 va; Pri (1-12) 115v, 60 cycles; Sec (3-4) 75v at 0.0150 amp; Sec (5-6) 75v at 0.075 amp; Sec (7-8) 6.3v at 2.0 amp; windings (3-4), (5-6), and (7-8) operate at ground potential; centerpoint of winding (7-8) is connected internally to case. Electrostatic shield between primary and secondary windings.				*	*	*
.1708	2Z9631.183		TRANSFORMER: impedance ratio of 17 to 68,000 ohms between windings (1-2) and (3-5) at 60 cycles; max. input to Pri 2/10v. Electrostatic shield between windings (1-2) and 3 (3-5) and magnetic shield around core and winding assembly.				*	*	*
.1709	2Z9632.247		TRANSFORMER: impedance ratio of 9,600 to 600 ohms between windings (4-6) and (1-3) at 60 cycles; d-c voltage to plate approximately 250v; coil will handle 10 watts.				*	*	*
.001 to .1600 not used .1601	3K4010311		CAPACITOR: mica; 0.01 mf ±10%; 300v dc working.			*	*	*	*
.1602	3DA30-21.1		CAPACITOR: paper; 0.03 mf ±10%; 1,000v dc working.			*	*	*	*

* Indicates stock available

10. MAINTENANCE PARTS LIST FOR KIT A96–U1 (contd).

Ref symbol	Signal Corps stock No.	Major comp	Name of part and description	Quan per unit	Orgn stock 1st ech	Orgn stock 2d ech	3d ech	4th ech	Depot stock
.1603	3DKA250-63		CAPACITOR: paper; 0.25 mf ±10%; 600v dc working.			*	*	*	*
.1604	3DA250-152		CAPACITOR: paper; 0.25 mf ±10%; 1,000v dc working.			*	*	*	*
.1605	3DA326		CAPACITOR: paper; 0.326 mf ±3%; 400v dc working.			*	*	*	*
.1606	3DB1.055		CAPACITOR: paper; 1.0 mf ±3%; 400v dc working.			*	*	*	*
.1606-A†	3DB5-78		CAPACITOR: 7 mf; dwg. D-169097 for motor.			*	*	*	*
.1607	2Z7279-69		POTENTIOMETER: wire wound; 1,500 ohms ±5%; 6 watts; winding tapped at 750 ohms ±5%; center tap brought out as a fourth terminal; 3/8″ diameter phenol fiber shaft projecting from rear 15/16″ (KS-9371, List 01).			*	*	*	*
.1608	2Z7270.168		POTENTIOMETER: wire wound; linear taper; 10,000 ohms ±10%; 4 watts; length of shaft 13/16″ with screwdriver slot.			*	*	*	*
.1609	2Z7270.169		POTENTIOMETER: wire wound; 19,000 ohms ±5%; 6 watts; wiring tapped at 9,500 ohms ±5%; 3/8″ diameter phenol fiber shaft projecting from rear 15/16″; 2 taps spaced 1,000 ohms brought out to the fourth center terminal (KS-9371, List 02).			*	*	*	*
.1610	2Z7272-177		POTENTIOMETER: composition; linear taper; 0.25 megohm ±20%; 2 watts; 13/16″ shaft with screwdriver slot.			*	*	*	*
.1611	3Z6020-45		RESISTOR: wire wound; 200 ohms ±5%; 10 watts; #1 terminal with "C" coating.			*	*	*	*
.1612	3RC21BE511J		RESISTOR: composition; 510 ohms ±5%; 1/2 watt.			*	*	*	*
.1613	3Z6132E5		RESISTOR: wire wound; 1,325 ohms ±5%; 10 watts; #1 terminal and "C" coating.			*	*	*	*
.1614	3RC21BE2725		RESISTOR: composition; 2,700 ohms ±5%; 1/2 watt.			*	*	*	*
.1615	3RC21BE272K		RESISTOR: composition; 2,700 ohms ±10%; 1/2 watt.			*	*	*	*
.1616	3RC21BE332K		RESISTOR: composition; 3,300 ohms ±10%; 1/2 watt.			*	*	*	*
.1617	3RC21BE103M		RESISTOR: composition; 10,000 ohms ±20%; 1/2 watt.			*	*	*	*
.1618	3RC21BE273J		RESISTOR: composition; 27,000 ohms ±5%; 1/2 watt.			*	*	*	*
.1619	3RC21BE473M		RESISTOR: composition; 47,000 ohms ±20%; 1/2 watt.			*	*	*	*
.1620	3RC21BE154M		RESISTOR: composition; 0.15 megohm ±20%; 1/2 watt.			*	*	*	*

Δ	.1621	3RC21BE224M	RESISTOR: composition; 0.22 megohm ±20%; 1/2 watt.			*	*	*	*
	.1622	3Z6727-24	RESISTOR: composition; 0.27 megohm ±20%; 1/2 watt.			*	*	*	*
	.1623	3RC21BE334M	RESISTOR: composition; 0.33 megohm ±20%; 1/2 watt.			*	*	*	*
	.1624	3RC21BE434J	RESISTOR: composition; 0.43 megohm ±5%; 1/2 watt.			*	*	*	*
	.1625	3RC21BE474M	RESISTOR: composition; 0.47 megohm ±20%; 1/2 watt.			*	*	*	*
	.1626	3RC21BE514J	RESISTOR: composition; 0.51 megohm ±5%; 1/2 watt.			*	*	*	*
	.1627	2Z8678.16	SOCKET: vacuum tubes; Octal.			*	*	*	*
	.1628	2J6SL7GT	TUBE VT-229, JAN 6SL7-GT.				*	*	*
	.1629	2J6V6GT/G	TUBE VT-107-A, JAN 6V6-GT/G.				*	*	*
	.1611-A‡	2Z7270.167	POTENTIOMETER: wire wound; linear taper 20,000 ohms ±10%; 4w; shaft length 15/16"; screwdriver slot used in place of rod.			*	*	*	*

* Indicates stock available
† New item added.
‡ Changes agreed upon at 1 April 1944 conference